

Global Battery

2025 Outlook: tailwinds to propel valuations

- Positive momentum in EV battery demand, utilisation and profitability; more usage in other areas to fuel growth in the long run
- Ex-China LFP penetration likely to accelerate from 2026; high-voltage mid-nickel NCM, SSB and 46-pi batteries still the development focus
- A Trump win would be positive for Chinese battery makers but negative for Korean companies

Negative

Neutral

Positive


Positive
 (unchanged)

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2025


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What's new: We foresee positive momentum for the global EV battery sector in 2025 across demand, supply and profitability. LFP battery penetration outside China is evident but will likely strengthen from 2026. We believe a Trump win would be positive for Chinese battery makers but negative for Korean companies due to possible changes in the IRA.

What's the impact: Eyes on an EU demand recovery. We forecast 1.6-1.9TWh global LiB demand over 2025-26E (unchanged), equal to 19-20% YoY growth, after 21% YoY growth for 2024E. We expect a mild recovery in NEV demand in Europe for 2025E on the back of a BEV model launch cycle, with volume growth accelerating in 2026E. Meanwhile, the new EU CO₂ regulations will likely drive BEV penetration higher over 2025-35, in our view (see our [Global NEV](#) report, 26 September 2024).

Profitability pressure to ease in 2025E. 1) On the supply side, we expect an improvement in battery capacity utilisation for 2025E (to 66% from 64% for 2024), driven particularly by capacity controls by Chinese makers since 2023. 2) Raw-material price volatility is no longer a material headwind for battery makers' profitability, in our view, after the 40-80% price drops from the peak level in 2022. For every USD1k/tonne drop in LiCO₃ and LiOH prices, we estimate the price impact on LFP and NCM cells is about 1%.

Technology path outlook. We believe rising LFP penetration in the ex-China market is a clear trend that will pick up from 2026 when Korean battery makers and global OEMs launch their LFP products. High-voltage, mid-nickel battery, all-solid-state battery (ASSB) and 4680 battery remain the development focus of global battery makers. For ASSB, cost is still an issue despite some battery makers claiming to have made breakthroughs.

Opportunities in e-trucks, e-vessels and aviation. We see longer-term battery applications in the e-truck, e-vessel, e-VTOL and e-jet areas. We estimate e-trucks will provide an extra 10-15% market growth, while e-vessels used for inland river transport in China offer 60% demand upside in the long run. The aviation market is more niche, eg, CATL targets to install a condensed matter battery in an 8-tonne payload e-jet from 2027-28.

What we recommend: We recommend CATL (300750 CH, CNY261.39, Buy [1]), Samsung SDI (006400 KS, KRW317,500, Buy [1]) and SK Innovation (096770 KS, KRW118,600, Buy [1]) considering their attractive 8-17x 2025E target PERs and positive earnings-growth momentum over 2025-26E. Key downside risk: lower-than-expected volume shipments.

How we differ: We are more upbeat on global EV battery supply-demand dynamics over 2025-26E.

Key stock calls

	New	Prev.
Contemporary Amperex Technology - A (300750 CH)		
Rating	Buy	Buy
Target	362.00	362.00
Upside	▲ 38.5%	
Samsung SDI (006400 KS)		
Rating	Buy	Buy
Target	600,000	600,000
Upside	▲ 89%	
SK Innovation (096770 KS)		
Rating	Buy	Buy
Target	140,000	140,000
Upside	▲ 18%	
LG Energy Solution (373220 KS)		
Rating	Hold	Hold
Target	400,000	400,000
Downside	▼ 4.8%	

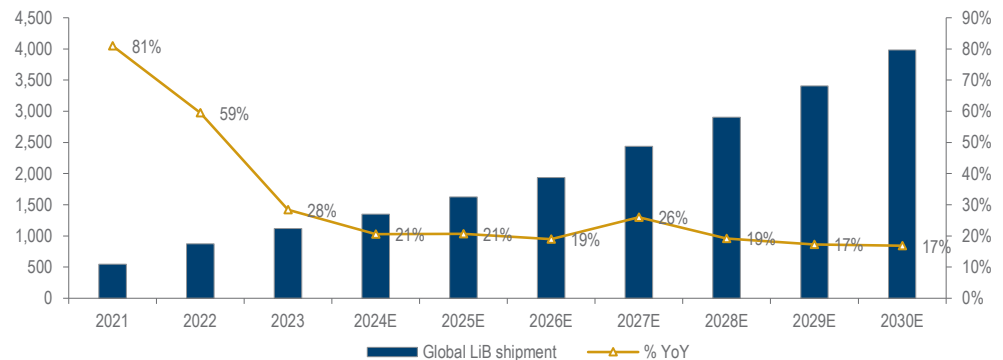
Source: Daiwa forecasts

Sector stocks: key indicators

Company Name	Stockcode	Share Price	Rating	Target price(localcurr.)	EPS(localcurr.)								
					FY1			FY2					
					New	Prev.	% chg	New	Prev.	% chg	New	Prev.	% chg
Contemporary Amperex Technology- A	300750CH	261.39	Buy	Buy	362.00	362.00	0.0%	10.760	10.760	0.0%	14.461	14.461	0.0%
LG Energy Solution	373220KS	420,000	Hold	Hold	400,000	400,000	0.0%	(2,267)	(2,267)	n.a.	8,007	8,007	0.0%
Samsung SDI	006400KS	317,500	Buy	Buy	600,000	600,000	0.0%	15,322	15,322	0.0%	34,549	34,549	0.0%
SK Innovation	096770KS	118,600	Buy	Buy	140,000	140,000	0.0%	6,951	6,951	0.0%	14,996	14,996	0.0%
Panasonic	6752 JP	1,425	Neutral	Neutral	1,400	1,400	0.0%	121.6	121.6	0.0%	189.8	189.8	0.0%

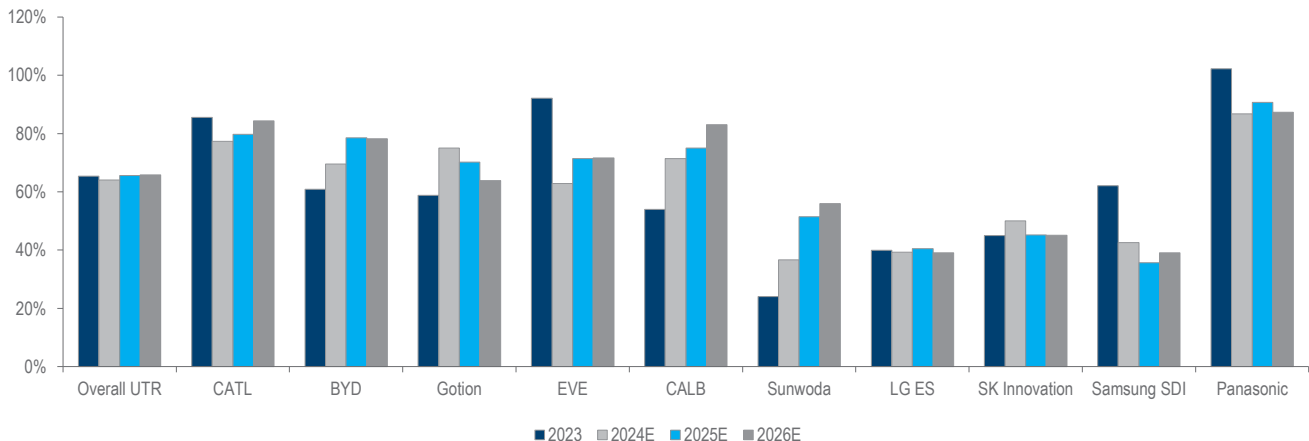
Source: Bloomberg, Daiwa forecasts

Global LiB shipments (GWh)



Source: EV Tank, Daiwa forecasts

Global battery capacity utilisation rate forecasts



Source: Company, Daiwa forecasts

Recent Global EV battery research:

[Contemporary Amperex Technology - A \(300750 CH\): Set for market-share growth in Europe](#)

[LG ENERGY SOLUTION: 3Q24 review: a mix of positives and negatives](#)

[Samsung SDI \(006400 KS\): 3Q24 review: bottoming out but slow recovery in 4Q](#)

[SK Innovation: 3Q24 review: waiting for a better 2025](#)

[Panasonic Holdings \(6752\): Small-group meeting with management](#)

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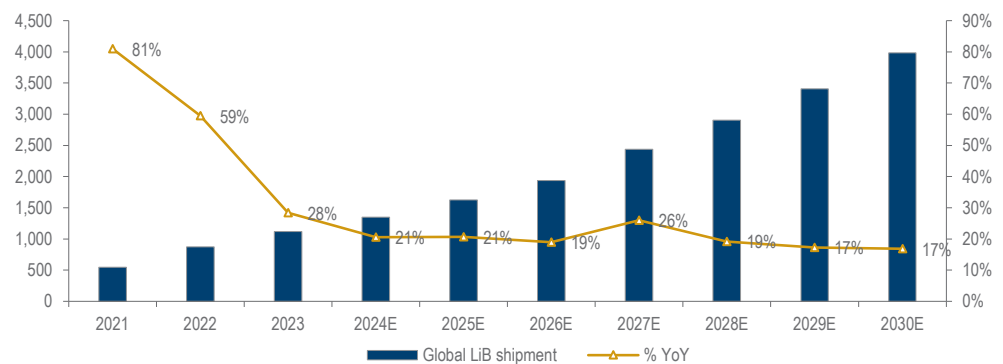
Global battery demand to remain robust in 2025E

Strong volume growth in 2025E on EU demand recovery

We forecast 19-21% global LiB shipments over 2025-26E to 1.6-1.9TWh

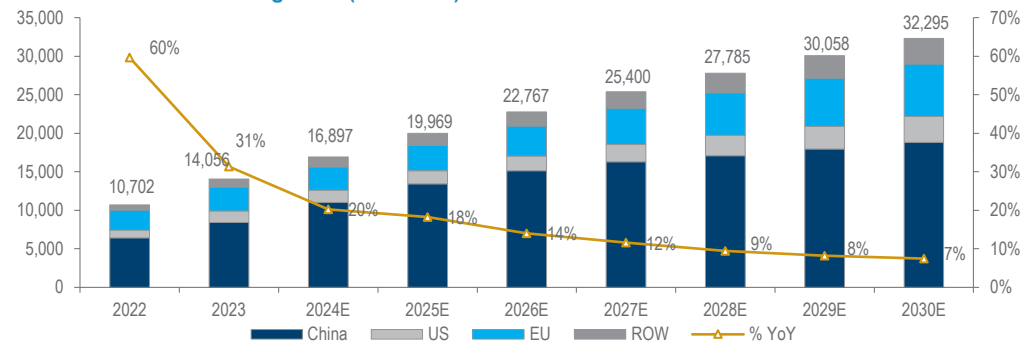
We maintain our forecast for global LiB shipments to reach 1.3TWh for 2024E (+21% YoY), followed by 1.6TWh for 2025E (+21% YoY) and 1.9TWh for 2026E (+19% YoY). By region, we believe NEV (BEV/PHEV) end-demand in Europe will recover to 9% YoY growth for 2025E (vs. a 2% drop for 2024E to 3m units) before accelerating in 2026E to 18% YoY. While China's market demand will likely remain robust in 2025E (+22% YoY to 13.4m units), Daiwa's US auto analyst, Jairam Nathan, believes US market growth will be modest in 2025E (see [Global NEV: Hybrid vehicles to drive growth; EU emissions targets the global game-changer](#)). We consider the LiB growth outlook intact considering still-low NEV penetration at c.12% globally in 2024E.

Global LiB shipments (GWh)



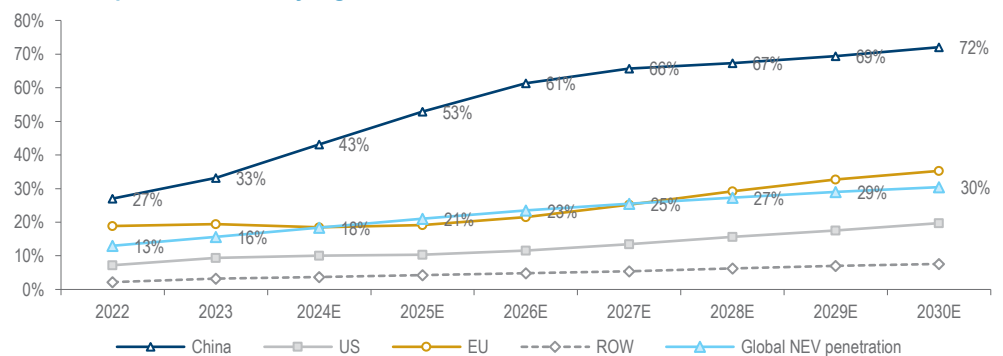
Source: EV Tank, Daiwa

Global NEV sales volume growth ('000 units)



Source: SNE Research, Daiwa

Global NEV penetration rate by region



Source: SNE Research, Daiwa

NEV launch cycle to be driven by EU CO₂ regulations from 2025E

Europe: the NEV launch cycle to be driven by CO₂ regulations

NEV sales in Europe for 8M24 were weak at 1.8m units (-4% YoY) including 1.2m units for BEVs (-5% YoY) and 0.6m units for PHEVs (-3% YoY). For the full-year 2024, we forecast a 2% YoY decline in NEV sales volume in Europe to 3m units. However, we expect EU NEV sales volume to recover to 3.3m units (+9% YoY) for 2025 driven by the new EU CO₂ regulation enforcement effective from 2025.

Specifically, over the 2025-29E period, the CO₂ average fleet emissions target for the EU will be cut to 93.6g/km for passenger vehicles, or by c.20% from the 2020-24 level. Further, over 2030-34, the passenger vehicle fleet emission requirement is scheduled to be reduced by 47% to 49.5g/km before the zero emissions requirement comes into force from 2035E. For OEMs that cannot meet the requirement, there will be a EUR95 per gram CO₂ per km penalty per the regulation (for details, please refer to our report: [Global NEV: Hybrid vehicles to drive growth; EU emissions targets the global game-changer](#)).

We believe 2025 will mark the year of a new NEV model launch cycle in Europe, and in 2026, expect NEV sales-volume growth to accelerate in the continent to 18% YoY to 3.9m units including 3.0m BEV units and 0.9m PHEV units. Considering the EU's ultimate zero emissions target by 2035 and c.47% cut by 2030 (vs. 2025-29), the model launch focus in Europe will likely be BEVs in our view as PHEV CO₂ emissions are still high at c.95g CO₂/km.

Europe: CO₂ emissions targets

Year	CO ₂ emissions requirement
2020-24 (NEDC)	Cars: 95 g CO ₂ /km Vans: 147 g CO ₂ /km
2025-29 (WLTP)	Cars: 93.6 g CO ₂ /km Vans: 153.9 g CO ₂ /km
2030-34 (WLTP)	Cars: 49.5 g CO ₂ /km Vans: 90.6 g CO ₂ /km
2035	zero emission for both cars and vans

Source: European Environment Agency, Daiwa

Estimation of % of BEVs needed to meet the EU's zero emissions targets

	% ICE	% BEV	% PHEV	Blended estimated CO ₂ Emission (g/km)	Requirement (g CO ₂ /km)	PV Sales (m)	BEV	PHEV	Total NEV	% YoY	BEV	PHEV	Total NEV
2023	76%	16%	8%	96	118.0	12.8	2.0	1.0	3.0				
2024E	78%	15%	7%	97	118.0	13.1	2.0	0.9	2.9	2%	-3%	0%	-2%
2025E	73%	20%	7%	91	93.6	13.1	2.6	0.9	3.5	0%	33%	0%	23%
2026E	67%	25%	8%	85	93.6	13.4	3.4	1.1	4.4	3%	29%	18%	26%
2027E	62%	30%	8%	80	93.6	13.8	4.2	1.1	5.3	3%	24%	3%	19%
2028E	52%	40%	8%	68	93.6	14.3	5.7	1.1	6.8	3%	37%	3%	30%
2029E	42%	50%	8%	56	93.6	14.7	7.3	1.2	8.5	3%	29%	3%	24%
2030E	30%	60%	10%	44	49.5	15.1	9.1	1.5	10.6	3%	24%	29%	24%
2031E	25%	65%	10%	39	49.5	15.6	10.1	1.6	11.7	3%	12%	3%	10%
2032E	20%	70%	10%	33	49.5	16.0	11.2	1.6	12.8	3%	11%	3%	10%
2033E	10%	80%	10%	21	49.5	16.2	13.0	1.6	14.6	1%	15%	1%	14%
2034E	0%	90%	10%	10	49.5	16.4	14.7	1.6	16.4	1%	14%	1%	12%
2035E	0%	100%	0%	-	-	16.5	16.5	-	16.5	1%	12%	-100%	1%

Source: European Environment Agency, ICCT, Daiwa estimates

NEVs are now the most popular choice among consumers in China

China: NEVs the most popular choice now

We forecast 2024E NEV sales volume of 11m units, up 31% YoY, with NEV penetration of 43%, up significantly from 33% for 2023. In May 2024, domestic NEV PV penetration hit 51%, and in August 2024 the penetration rate rose further to 57% thanks to the proliferation of PHEVs and EREVs, in our view. In the first eight months of 2024, China's PHEV sales volume rose by 84% YoY to 2.8m units, representing 40% NEV sales. However, BEV sales volume was moderate at 10% YoY during the period to 4.2m units. For 2025, the PHEV growth momentum will likely continue. We forecast a c.50% market share for PHEVs in 2025E with volume growth of 40% YoY vs. 8% for BEVs. As a result, we forecast 22% NEV sales volume growth in 2025E in the China market to 13.4m units, followed by 13% growth to 15.1m units in 2026E.

US market: BEVs set to take a backseat to HEVs

For the US market, Daiwa's Jairam Nathan expects BEV sales volume growth to be flat YoY for 2024E and he does not have high expectations for 2025 even with the low penetration. Jairam forecasts only a 5-10% YoY growth range for 2025E (with a mid-point of 7.5%), mainly attributable to the lack of new models after GM's heavy releases in 2024 and Tesla planning its affordable BEV model in 2H25. For HEVs (or FHEVs) and PHEVs combined, Jairam forecasts c.30% YoY sales-volume growth for 2024E and 20% YoY for 2025E. Unlike China, PHEVs still have lower penetration in the US, growth over 2024-25 will likely be driven by HEVs (see [Global NEV: Hybrid vehicles to drive growth; EU emissions targets the global game-changer](#)).

We believe a Trump win would be positive for Chinese battery makers and negative for Korean companies due to possible changes in the IRA. His inclination to nullify the IRA suggests a negative outlook for Korean EV battery sentiment. However, it is challenging to entirely repeal the IRA, as any changes to the law would require legislative amendments by the US Congress, and some Republicans and large corporations resist repealing it. Depending on the extent of modifications (e.g., budget cuts for subsidies, increased MSRP for subsidy-eligible vehicles), the negative impact could persist longer.

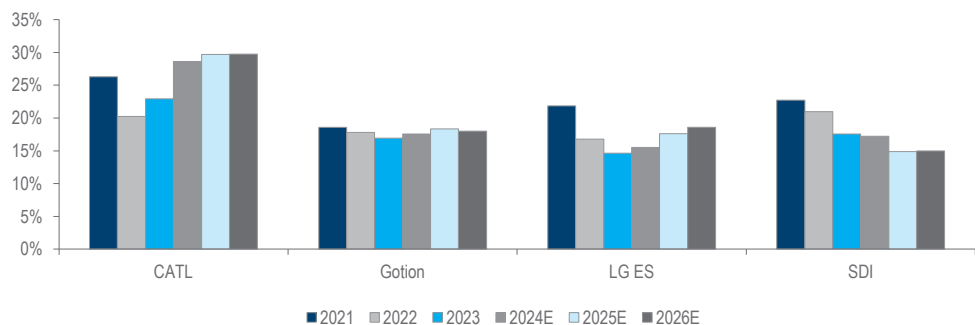
For Chinese battery makers, any cut in tax credits would be positive as they can continue supplying to the US. Companies like Gotion (002074 CH, CNY23.67, Buy[1]), which already have factories in the US, should be well-received by the Trump administration. Similarly, the CATL-Ford licensing agreement may also have a chance to proceed, given that it fulfils the 'US manufactured and managed by the US side' principle.

Battery sector fundamentals are set to improve in 2025E

Profitability pressure factors to ease from 2025E

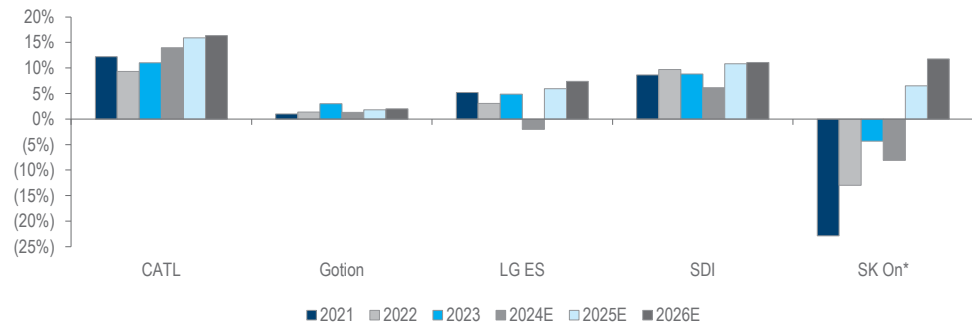
The decline in battery prices and battery capacity over-supply since 2023 have been the major headwinds for the global battery sector in terms of profitability. We believe the profitability outlook for battery makers is brighter for 2025 as the negative factors start to fade. We see limited room for downside for further battery price corrections in 2025. Further, the battery sector utilisation rate is likely to pick up from 2025 thanks to capacity controls since 2H23.

Global battery: gross margin by player



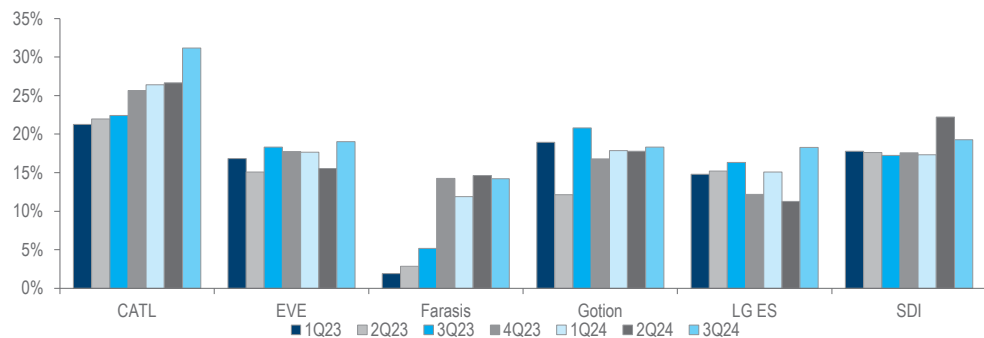
Source: Company, Daiwa forecasts

Global battery: net margin by player



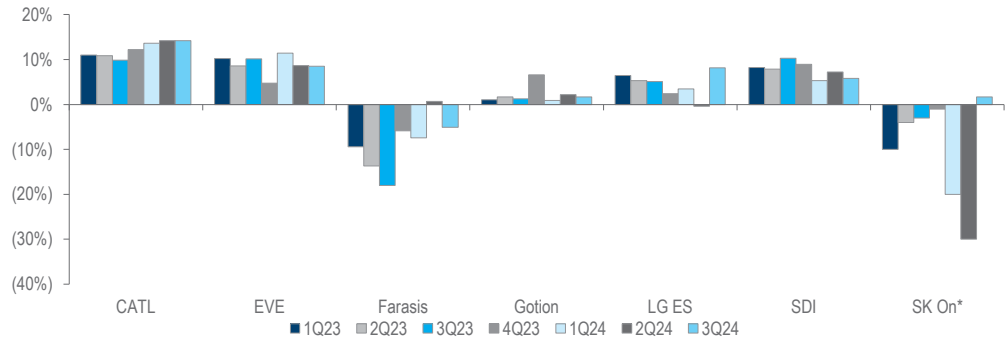
Source: Company, Daiwa forecasts, *OP margin for SK On

Global battery: quarterly gross margins



Source: Company, Daiwa

Global battery: quarterly net margins



Source: Company, Daiwa, *OP margin for SK On

Battery material price volatilities are no longer a material factor for profitability

Battery profitability: limited impact from the battery price correction

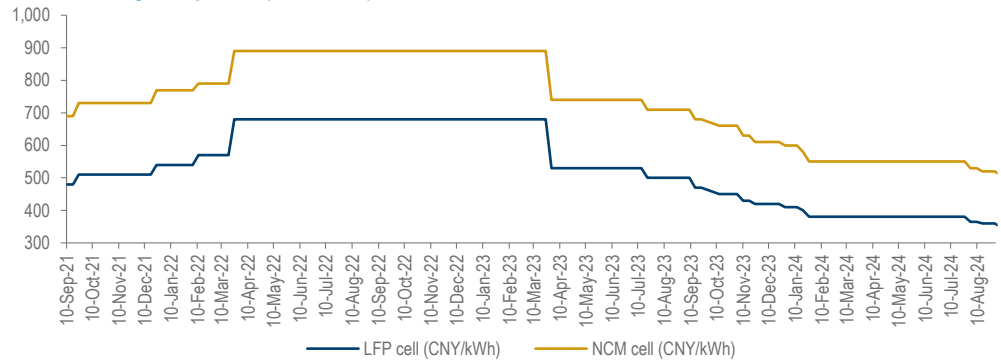
Battery prices started to fall in April 2023 due to the correction in battery materials prices, especially lithium carbonate. According to Zeyan Consulting, a third-party battery data vendor in China, the current NCM cell price is c.CNY510/kWh, down by 43% from the peak level in 2022. LFP battery cells also recorded a 49% correction to CNY350/kWh during the period. The lithium carbonate price has declined significantly by 87% to CNY76k/tonnes currently from the peak level of CNY580k/t in November 2022.

Going forward, even if lithium carbonate prices drop further, we believe the decline would be limited, and the impact on battery players' profitability would be limited or minor. After the 87% decline (c.CNY500k/t in absolute value) in the price since the peak, we estimate that even if the price drops by a further CNY25k/t to c.CNY50k/t (the price level before the NEV boom in China in 2020), the impact on battery prices would be minor and significantly below the CNY500k/t decline impact seen since late 2022. On our estimates, for every

CNY10k/t decline in lithium carbonate prices, LFP battery cell prices drop by CNY6.3/kWh, representing 1.8% of the current LFP battery cell price.

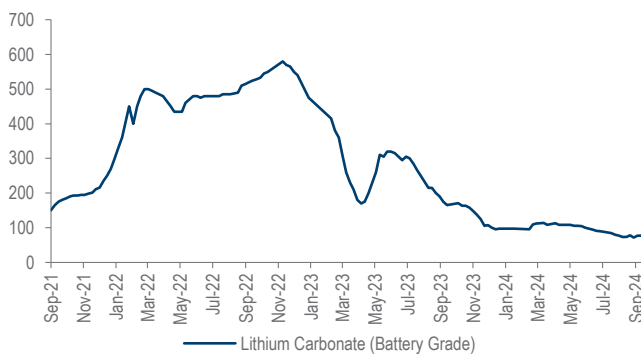
For other battery materials prices, we believe the downside is also limited, as mid-stream suppliers are now under significant earnings pressure, with only the top makers generating a thin net margin now.

China: battery cell prices (CNY/kWh)



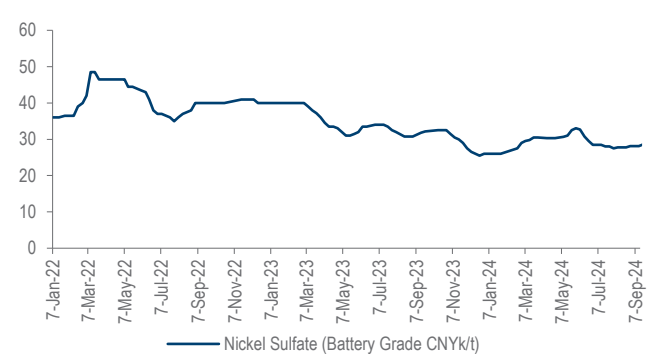
Source: Zeyan, Daiwa

China: LiCO₃ price (CNYk/t)



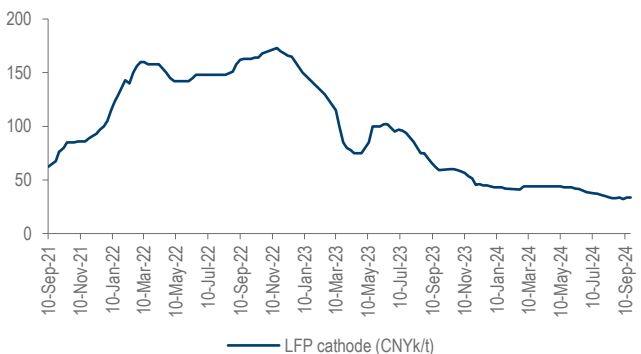
Source: Zeyan, Daiwa

China: nickel sulphate price



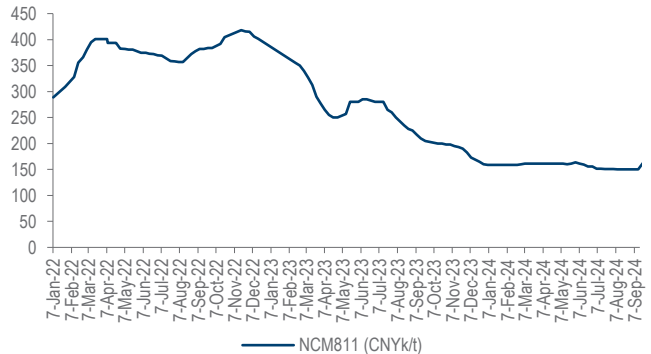
Source: Zeyan, Daiwa

China: LFP cathode price



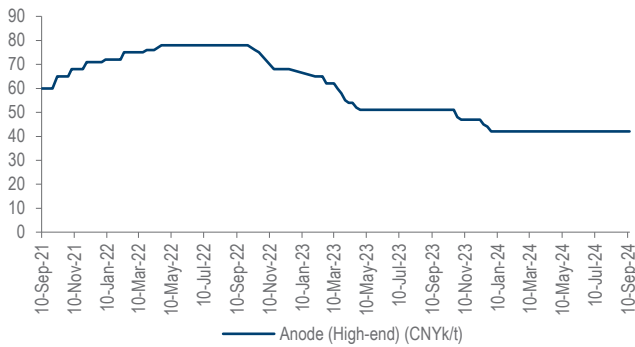
Source: Zeyan, Daiwa

China: NCM811 cathode price



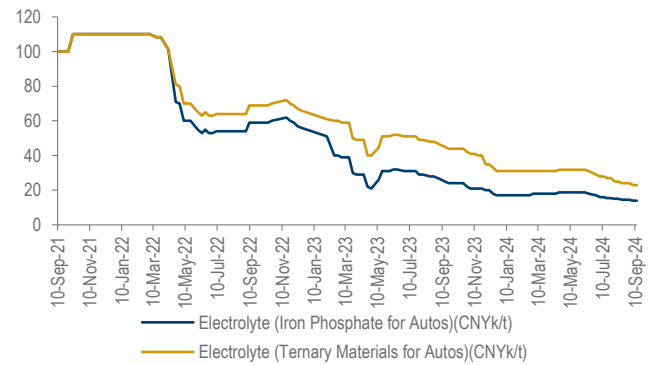
Source: Zeyan, Daiwa

China: anode price



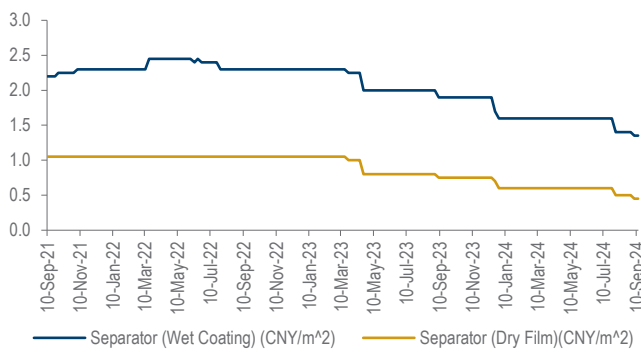
Source: Zeyan, Daiwa

China: electrolyte prices



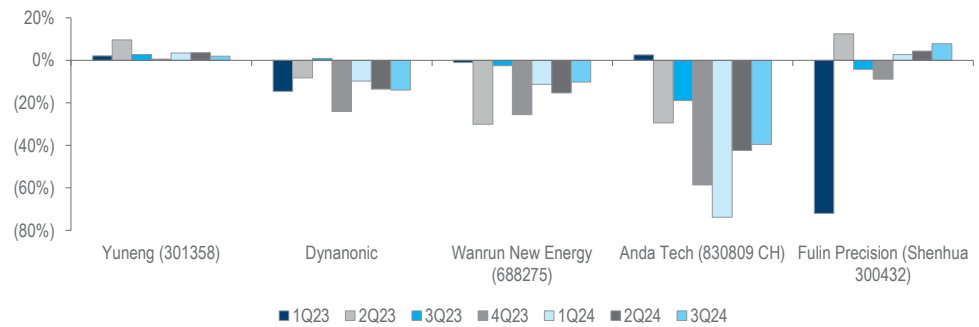
Source: Zeyan, Daiwa

China: separator prices



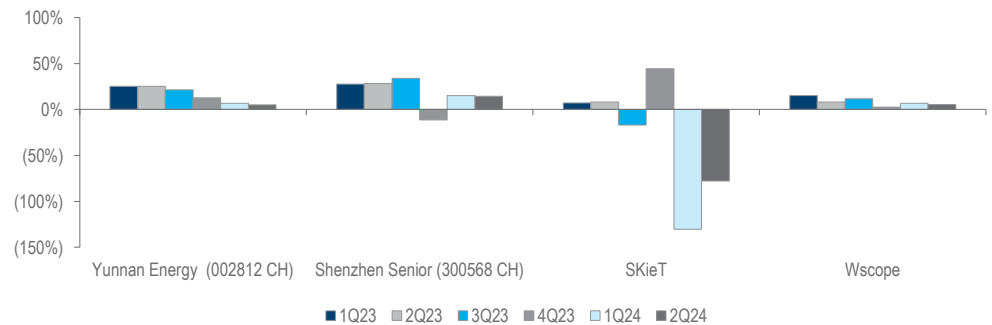
Source: Zeyan, Daiwa

China: LFP cathode player net margins



Source: Company, Daiwa

Global: separator player net margins



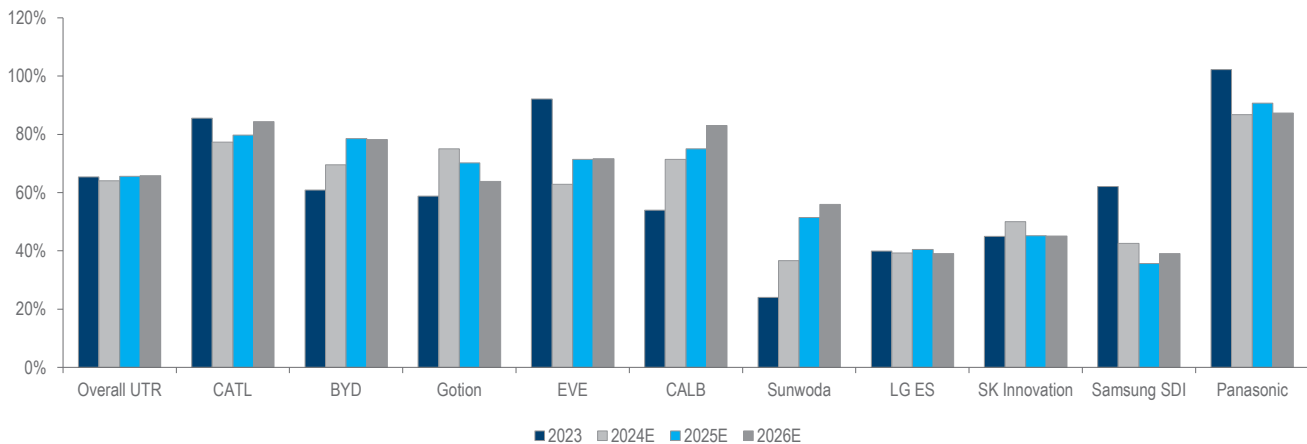
Source: Company, Daiwa

We look for global battery utilisation to pick up in 2025, thanks to capacity controls

Battery utilisation poised to improve in 2025E

Thanks to the stringent capacity controls in 2023 and 2024, along with sustained solid battery demand growth over 2025-26E, we anticipate that global battery utilisation rates will bottom out in 2024E, before picking up over 2025-26E. Our sample companies include CATL, BYD, Gotion, EVE Energy, CALB, LG ES, SK Innovation, Samsung SDI and Panasonic, which collectively accounted for c.90% of the global EV battery installations for 8M24. We expect capacity utilisation rates of top Chinese companies to range from 50-85% over 2025-26E, healthier than Korean companies at around the 50% level. The low utilisation rate for the Korean companies is in part due to the subdued NEV demand growth in the North America market, in our view, especially as the Korean battery makers tend to have JVs with local US OEMs.

Global battery: battery capacity utilisation rate forecasts



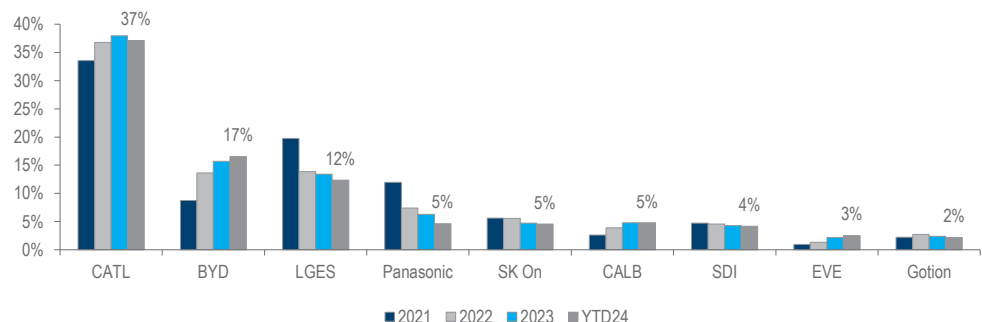
Source: Company, Daiwa forecasts

Korean battery companies: JVs in North America

SDI	
StarPlus (JV w Stellantis)	
1st factory (Kokomo Indiana)	33 GWh operational from 2025
2nd factory	34GWh from end-2026
JV w GM	30GWh operational from 2026
SK On	
BlueOval SK (JV w Ford)	127GWh operational from 1Q25
HMG NA JV	35GWh operational from 4Q25
GM JV (Georgia)	22GWh operational from 2022
LG ES	
Ultium Cell (JV w GM)	
Phase 1 (OH)	41GWh operational from 2022
Phase 2 (TN)	41GWh operational from 2023
Phase 3 (MI)	41GWh operational from 4Q24
Honda JV (OH)	40GWh operational from end-25
NextStar (JV w Stellantis / ON, Canada)	45GWh operational from 1Q24

Source: Company, Daiwa

Global EV Battery: EV battery market share by company



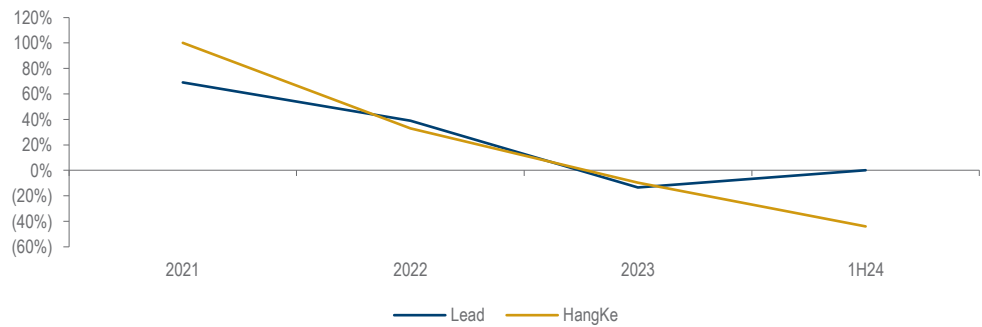
Source: SNE Research, Daiwa

Battery equipment makers have seen continuous weakness in orders since 2H23

Capacity controls by China battery makers

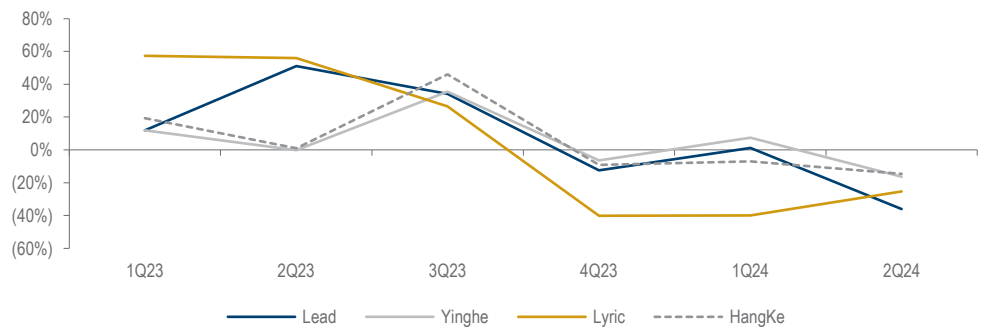
The capacity controls by China battery makers are reflected in the new order intake and revenues of battery equipment players. Specifically, equipment players started to record YoY revenue declines from 3Q23 as battery players started to postpone capacity construction and delayed order confirmations. Further, in 1H24, Wuxi Lead's revenue fell by 19% YoY to CNY5.7bn while YoY revenue declines were also seen for Yinghe (-18% to CNY2.7bn for the equipment segment), Lyric (-32% YoY to CNY1.8bn) and HangKe (-11% YoY to CNY1.9bn). In terms of new order intake, Wuxi Lead's was flat YoY for 1H24, following a 13% drop for 2023. For HangKe, we estimate about a 44% YoY drop in new order intake in 1H24 due to the sluggish domestic market demand. The weak YTD new order intake suggests disciplined capacity expansion in China's market for in 2025E.

New order growth for Wuxi Lead and HangKe



Source: Company, Daiwa

China: LiB equipment player revenue growth



Source: Company, Daiwa

Global battery technology trend

We expect the LFP battery to quickly penetrate the ex-China market from 2026

LFP battery adoption is a clear global trend

The LFP battery now dominates the China EV battery market with a c.71% market share in the first 8 months of 2024, according to CABIA. We believe the LFP battery is popular in China for the following reasons: 1) its 30% cost advantage over the NCM battery, 2) although the LFP battery cell has lower energy density than NCM, it provides sufficient driving needs; for example, the Xiaomi SU7 Pro version with CATL's Shenxing battery can support up to 830km driving range; and 3) the LFP battery is also capable of 5C super-fast charging. However, at low temperatures (ie, zero degrees Celsius), the LFP battery still loses capacity quickly. CATL's current R&D focus is on improving the LFP battery performance at low temperatures so that it can be well adopted in cold areas, including Europe and North America.

While currently only Chinese battery makers produce LFP batteries, Daiwa's Korea battery analyst, Henny Jung, believes Korean battery makers have also allocated resources to LFP battery research, given rising client demand in the ex-China market. Specifically, LG ES aims for LFP battery mass production in late 2025. Recently, LG ES won its first LFP order from Renault, with the start of production (SOP) from November 2025. Samsung SDI plans to produce the LFP/LFMP battery in volume from 2026, per the company. LFMP is also being researched by LG ES, according to LG ES's management.

Global OEMs such as Ford, GM, VW and Toyota have revealed plans to start using LFP batteries from 2025-26E. As such, we believe the LFP battery is set to penetrate the ex-China market. In the ex-China market, we estimate that in 2023, the LFP battery penetration rate was about 15% (c.57GWh) due to the export of China NEVs and China LFP battery exports. Over 2024-25E, we expect LFP penetration to increase to 17-20% driven by China NEV and EV battery export growth. From 2026-30E driven by Korean battery makers' LFP battery introduction and global OEMs' shift from the NCM battery to the LFP battery, we forecast ex-China LFP battery penetration to rise to 25% in 2026E and 40% in 2030E.

The potential of the M3P battery in ex-China markets

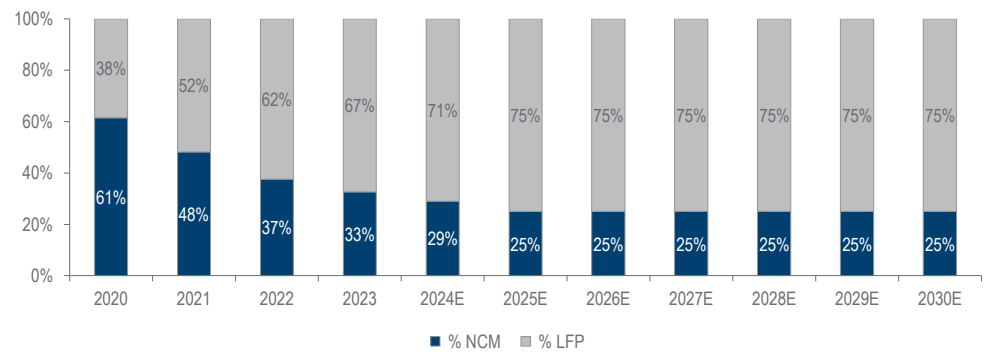
According to CATL's management, it sees opportunities for the M3P battery in the European market given its lower cost than the NCM and better performance at low temperatures than LFP batteries. Currently in China, the M3P battery is already commercialised. We see the possibility of CATL also bringing the M3P battery to ex-China markets.

Global battery: technology road map

	2021	2022	2023	2024E	2025E	2026E	2027E	2030E
	LFP 180-200Wh/kg	HV NCM / GR 240-260Wh/kg	HV LxFP 210-230Wh/kg	Shenxing battery (5C super fast charging battery)			ASSB	
CATL	HV NCM / GR 220-240Wh/kg	HN NCM / SiOx-GR 300-400Wh/kg	Qilin battery (CTP3.0 with 72% pack utilisation rate)	Shenxing Plus (pack energy density 205Wh/kg)	1. LFP with improved low temperature performance 2. Gen 2 NiB 3. Freevay hybrid battery			1. Rare metal free LiB 2. Li-Air battery 500-600+ Wh/kg
	HN NCM / GR 240-300Wh/kg		Condensed matter battery (500Wh/kg)					
LGES	NCM811 / Silicon anode (3-5wt %)	NCMA	NCM955	1. 4680 battery trial run 2. LFP for ESS	1. 94%-95% Nickel 2. HV mid-nickel NCM 3. 4680 battery SOP	1. LFP battery	1. Polymer-based solid-state (SSSB) 2. Mn-rich & LFMP battery	Sulphide-based solid-state (ASSB) & Li-S
SKI	NCM811	NCM955	Silicon anode (3-5wt %)		94%-95% Nickel 1. P7 (Si-Carbon-Nanocomposite) 2. 46-pi batteries (early 2025 from micro-mobile)		Li-metal, Solid state	
SDI	P5 (NCA, 88% Nickel)		P6 (Si-Carbon-Nanocomposite)			LMFP/LFP+ batteries	1. P8 2. All solid state battery	Advanced solid state
Panasonic				4680 battery		Cobalt-free battery		Nickel-free battery after 2030
Toyota (PPES)						1. Hi-NCM for 1000km driving range 2. Bipolar LFP (2026-27)	1. Bipolar NCM (2027-28) 2. ASSB	

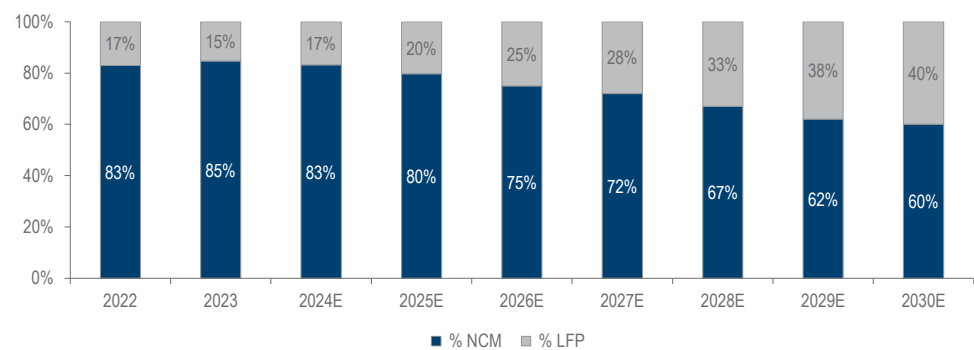
Source: Company, Daiwa

China: EV battery share split by chemistry



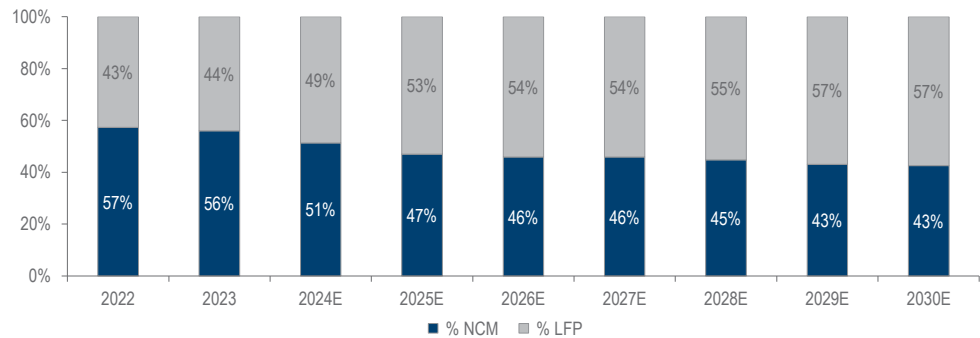
Source: CABIA, Daiwa estimates and forecasts

Ex-China: EV battery share split by chemistry



Source: Daiwa estimates and forecasts

Global: EV battery share split by chemistry



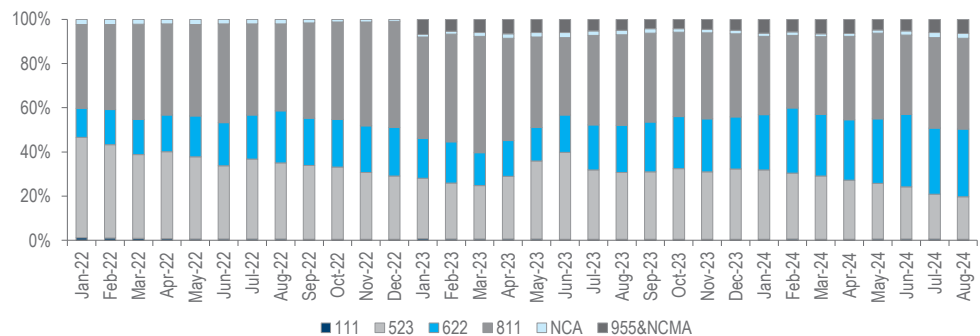
Source: Daiwa estimates

High-voltage mid-nickel strategy by Korean cell makers

Korean battery makers are also looking into the HV MN battery for the volume market

Apart from the LFP battery cell, Daiwa's Henny Jung believes another key strategy for Korean battery cell makers is high-voltage mid-nickel (HV MN) NCM battery cell products, aiming to be introduced from 2025. The 60% HV MN NCM cell achieves similar energy density to the nominal-voltage 80% nickel products due to higher voltage. Meanwhile, the cost for HV MN products is attractive compared with the nominal-voltage high nickel products due to less nickel requirement. We see these as key strategy for Korean cell makers to gain market share in the entry and volume NEV segment. In fact, in China's market, LFP cathode and HV MN products are mature and well adopted by local OEMs, currently.

China: NCM cathode production volume breakdown



Source: ICCSINIO, Daiwa

Solid state battery update

Semi-solid-state batteries (SSSB) entered the market from late 2023

We estimate a CNY2,000/kWh battery pack price for the SSSB

The SSSB was already in the market in China from late 2023. However, given the super-high cost, demand has been very low. NIO introduced a 150kWh semi-solid-state battery (SSSB) in late 2023. The battery is produced by Welion (not listed) with a cell energy density of 360Wh/kg and can support up to a 1,000km driving range. The 150kWh SSSB is only available for rent because it is too expensive for sale, according to NIO. We estimate that the cost of this battery is about CNY2,000/kWh, vs. CNY700/kWh for an NCM battery pack and CNY500/kWh for an LFP battery pack.

Meanwhile, CATL launched a condensed matter battery in 2023, with an energy density of 530Wh/kg, which is ready for mass production. However, given the high price, there is little interest from OEMs. CATL plans to apply the condensed matter battery in the aviation sector, which is not cost-sensitive.

ASSBs are scheduled to be produced in 2027

All-solid-state battery (ASSB) from 2027

Korean and Japanese battery makers' general production timeline for the ASSB is around 2027, unchanged from the guidance they shared in 2023. CATL, in September 2024, provided an update on its ASSB development. Currently, on a scale of 1-9 (1 being proof of concept and 9 being ready for production), CATL's ASSB development is at level 4, per the company. CATL believes that there are still a number of problems to fix with the ASSB, especially interface issues.

In August, Great Power (300438 CH) introduced an ASSB with an energy density of 280Wh/kg and charging cycle of 600 times. Narada (300068 CH) in September also released a 20Ah ASSB product with an energy density of 350Wh/kg and charging cycle of 2,000 times. In our view, the 2,000 times charging cycle looks attractive and is sufficient for EV applications. However, we suspect that the 2,000 times charging cycle is limited to certain conditions (ie, at certain temperatures and atmospheric pressure) and is not ready for commercial application yet.

Solid state battery development timeline

Solid state battery development	
Samsung SDI	Volume production in 2027 for ASSB
LG ES	SSSB in 2027 and ASSB in 2030
Toyota	ASSB in 2027
CATL	SSSB ready for production; ASSB in small volume production in 2027

Source: Company, Daiwa

Opportunities in other areas

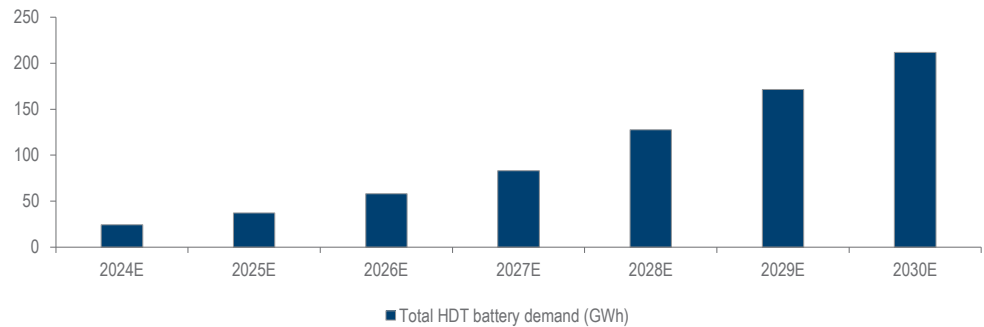
E-trucks offer 10-15% extra market opportunities for battery makers, per our estimates

The e-truck is seeing increasing penetration

The electrification of trucks is already happening, and we note the growing popularity of these vehicles, especially for shorter travel distances of <300km. For longer journeys, diesel and LNG still have an advantage due to the limited driving range for e-trucks at the moment (mostly 300-500km).

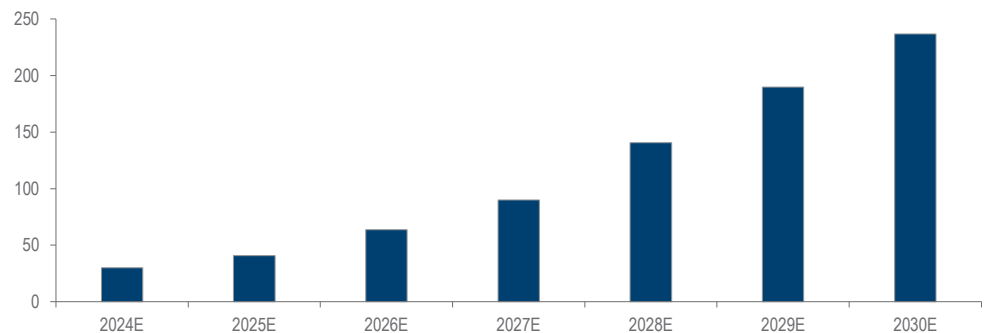
According to our estimates, the e-truck has better utilisation on shorter journeys which comprise around 30% of the demand, and also for those medium to mini-sized trucks (which often serve shorter distances as well), we estimate the battery demand from China itself to be around 346GWh by 2030. We see further upside potential from global markets, especially Europe. Combined with global HDT demand, we estimate a total of 448GWh of battery demand by 2030, which suggests 10-15% upside from the existing EV+ESS battery demand of only 4%.

Global battery demand for HDT trucks (GWh)



Source: Daiwa estimates and forecasts

China: battery demand from non-HDT segment (GWh)



Source: Daiwa estimates and forecasts

Inland river transportation is a feasible starting point for e-vessels

Marine: potential comparable to that for EVs

Apart from extending the use of a battery to ESS and e-trucks, as well as previously mentioned aviation, we believe the greatest potential may be derived from e-vessels on the marine side. According to MIIT data from 2022, the Chinese government plans to develop the basic infrastructure for e-vessels along the country's inland river transportation network, as well as pushing for the development of a related supply chain. In our view, e-vessels would suit domestic inland river transportation, due to the relatively fixed routes and shorter distances than international ocean transportation. Therefore, the range requirement is lower.

For example, there are ports along the Yangzjiang River every 100-200km from Shanghai to Chongqing. Thus, for the recent e-vessel operated by COSCO (COSCO Green Water 01), its sailing range of 380km is adequate for this type of transportation. E-vessels can start operations as soon as the charging infrastructure is ready (they use the battery swap method, which is the method adopted by the COSCO Green Water 01).

We believe the market potential for marine is not less than that for the EV market

Using the specifications of the most recent COSCO Green Water 01 (with a 50MWh battery) as our basis for energy demand, and multiplied by the annual tonne mileage, we estimate the TAM would yield a 44TWh market (we can provide a detailed calculation upon request). Assuming a replacement pace of 3%, this would lead to annual demand of 2TWh of batteries, say by 2030, which is close to that for the EV battery market and offers c.60% upside potential from EV+ESS LiB shipments in 2030.

Now the major hurdle is cost, whereby the cost of a single battery pack (around 1600-1900kWh) for an e-vessel can be as much as CNY3m, which is far higher than the cost of an EV battery on a per kWh basis. However, we see room for a decline in cost if the scale increases in the future. We expect penetration and awareness of e-vessels to continue to improve in the coming years and thus provide an additional market for battery makers. This would particularly benefit battery makers, especially companies like CATL and EVE Energy, that have already started to provide batteries in this area.

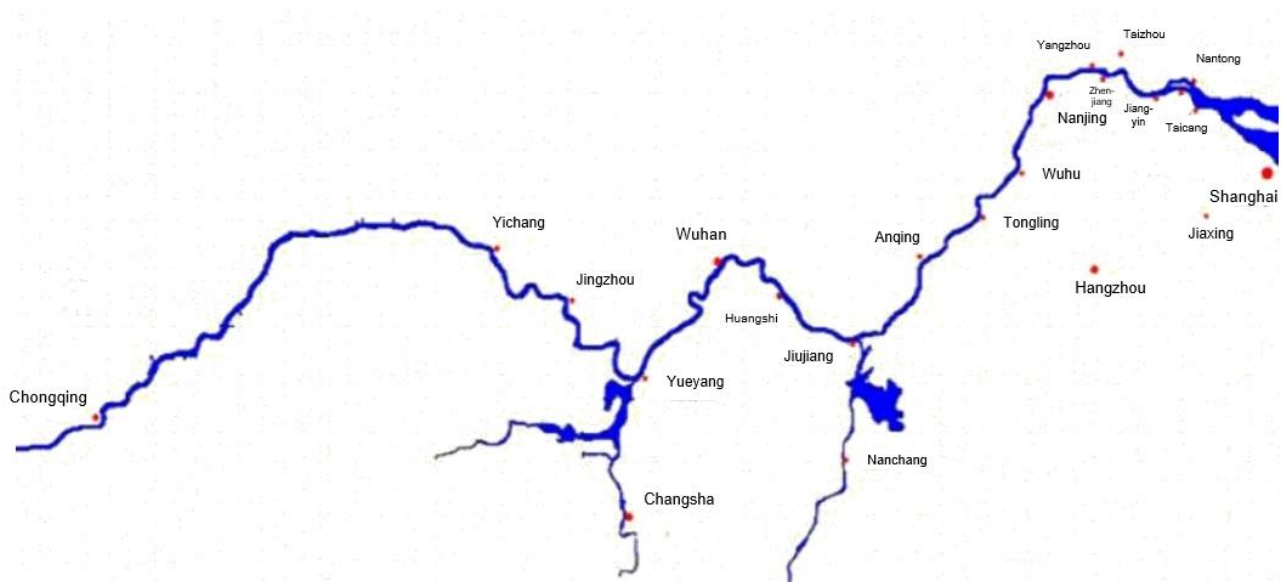
COSCO: COSCO Green Water 01



Source: Company

COSCO Green Water 01: illustration of a battery change


Source: Company

Ports along Yangtze River


Source: Daiwa, China Transport Bureau

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Aviation: eVTOL and e-jets

We see future business opportunities in the electric vertical take-off and landing (eVTOL) and e-jet areas. For eVTOL, it is still in the early development stage, and the Chinese government plans to explore low-altitude economic opportunities. EHang in China is the only company that has received an eVTOL production certificate for commercial use. EHang delivered 52 units of eVTOL in 2023 and 75 units in 1H24, per its management. Each eVTOL carries about a 30kWh battery, suggesting c.1.6MWh of battery usage for eVTOL applications in 2023.

1.93m	5.73m	620kg	30km	130km/h
Aircraft height	Aircraft width	Maximum takeoff weight	Maximum range	Maximum design speed

All specifications are for reference only and is subject to change without prior notice.

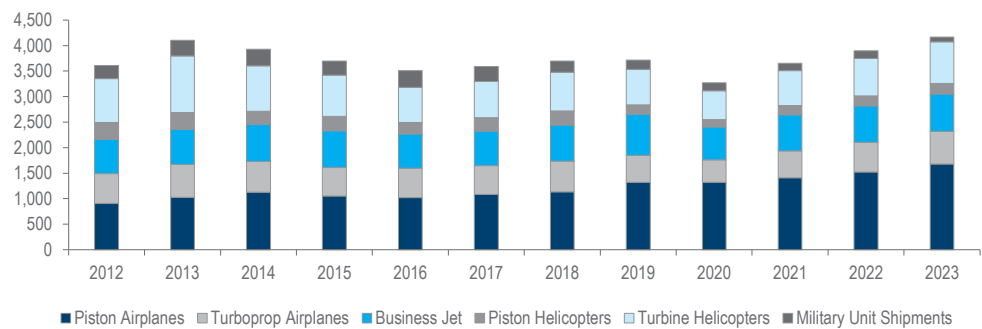
The 8-tonne payload e-jet is due to be introduced over 2027-28

CATL is working with China aerospace company Comac on electric aircraft development. Using CATL's SSSB, which provides an energy density of 500Wh/kg at the cell level, will enable CATL/Comac to introduce an 8-tonne payload aircraft over 2027-28, with a flying range of 2,000-3,000km. Note that CATL is making progress by having already completed testing for a 4-tonne payload aircraft.

Currently, we cannot judge the economics of this 8-tonne payload e-jet, but based on the limited specifications available currently, we believe it should be comparable to a 40-50-seater regional jet, such as the ERJ series from Embraer, the Dash 300-400 series, and very close to the COMAC ARJ from previous years. As we don't know how much battery would be equipped in each e-jet, we cannot estimate the cost competitiveness. However, by using a battery system in the 8-tonne e-jet as opposed to a traditional power system might provide opportunities for cost savings.

If CATL's endeavours with Comac are successful, this would create new demand for CATL's battery products, setting CATL apart from other secondary battery makers.

Global aircraft deliveries



Source: GAMA

CATL: condensed matter battery



Source: Company, Daiwa

Valuations, recommendations and risks

Reasonable valuation given still a growth sector

Battery makers, excluding LG ES, are trading at 8-19x 2025E PERs

Global EV battery players are trading at reasonable PERs, in our view. For example, Chinese battery makers are trading at 16-19x 2025E PERs, and Korean and Japanese players, like Samsung SDI, SK Innovation and Panasonic, are trading at 8-17x 2025E PERs. However, LG ES is still trading at a premium to its Korean and Chinese peers at a 53x 2025E PER, due likely to its pure play position in the battery space and thin net margins.

The battery sector is still a growth sector given the still-low global NEV penetration at 18% for 2024E, and we expect a tailwind for NEV sales volume over 2025-26E leading to 14-18% YoY growth, thanks to the EU CO2 regulation update from 2025E. We also expect industry capacity utilisation to improve from 2025E, with a better profitability outlook. All things considered, we recommend investors accumulate high-quality battery players with reasonable valuations.

Global EV battery: valuation

Name	Bloomberg Code	Trading Currency	Share price 5-Nov-24	Rating	PER (x)		PBR (x)		EV/EBITDA(x)		Div yield (%)		ROE (%)		
					FY24E	FY25E	FY24E	FY25E	FY24E	FY25E	FY24E	FY25E	FY24E	FY25E	
China players															
Gotion	* 002074 CH	CNY	23.67	Buy	31.0	19.1	1.7	1.5	15.6	12.5	n.a.	n.a.	5.5	8.3	
CATL	* 300750 CH	CNY	261.39	Buy	24.3	18.1	5.1	4.0	12.8	9.7	0.9	1.2	22.3	24.9	
BYD	* 1211 HK	HKD	294.20	Buy	19.9	16.2	4.6	3.8	7.8	6.4	1.5	1.9	25.5	25.8	
	Weighted average				25.1	17.8	3.8	3.1	12.1	9.5	1.2	1.5	17.8	19.7	
	High				31.0	19.1	5.1	4.0	15.6	12.5	1.5	1.9	25.5	25.8	
	Low				19.9	16.2	1.7	1.5	7.8	6.4	0.9	1.2	5.5	8.3	
	Median				24.3	18.1	4.6	3.8	12.8	9.7	1.2	1.5	22.3	24.9	
Global players															
SAMSUNG SDI	* 006400 KS	KRW	317500.00	Buy	20.7	9.2	1.0	0.8	5.2	3.4	0.3	0.3	5.2	9.9	
SK Innovation	* 096770 KS	KRW	118600.00	Buy	17.1	7.9	0.4	0.4	na	7.0	1.7	1.7	2.9	5.4	
LG ES	* 373220 KS	KRW	420000.00	Hold	n.a.	52.5	4.4	3.9	31.0	16.6	n.a.	0.2	n.a.	7.9	
	Weighted average				24.3	18.1	4.6	3.8	12.8	9.7	1.2	1.5	22.3	24.9	
	High				20.7	52.5	4.4	3.9	31.0	16.6	1.7	1.7	5.2	9.9	
	Low				17.1	7.9	0.4	0.4	5.2	3.4	0.3	0.2	2.9	5.4	
	Median				18.9	9.2	1.0	0.8	18.1	7.0	1.0	0.3	4.0	7.9	

Source: Bloomberg, * Daiwa forecasts

Recommendations

CATL (300750 CH, CNY261.39, Buy [1])

Rating opportunities backed by the EU's NEV sales volume recovery. We forecast CATL to post 24-34% YoY net-profit growth over 2024-25E to CNY63-80bn on the back of 20-22% YoY battery volume growth to 577-706Wh. Due to the CO₂ emissions regulations in Europe, we expect NEV sales volume in the EU market to recover in 2025 and accelerate further in 2026E, bolstering CATL's volume growth. CATL is trading currently at a 18x 2025E PER, and we see a rating opportunity for the stock with an EU market demand recovery.

Reaffirming its leadership position in global battery technology. We believe CATL's battery technology leads the world across various battery chemistries, including LFP, NCM and NiB. The ex-China EV market transition to LFP chemistry is set to benefit CATL, as its Shenxing LFP battery is currently one the best in the world in that it can support a 1,000km driving range and has super-fast charging. CATL is also working with Comac on e-jet development by leveraging its 500Wh/kg condensed matter battery. The 8-tonne payload e-jet is due to be introduced in 2027-28E, according to its current development plan.

Our 12-month TP of CNY362 is based on a 25x 2025E EPS. We reaffirm our Buy (1) rating on CATL. Key downside risk: lower-than-expected volume and gross margin.

Samsung SDI (006400 KS, KRW317,500, Buy [1])

Despite muted EV demand amid the EV sales-volume chasm, we expect Samsung SDI to record solid earnings in 2025 on increasing demand for prismatic-type EV batteries and recognition of advanced manufacturing production credits (AMPC). We are also positive on its long-term growth given its aggressive stance towards capex based on its high profitability and leadership in next-generation products and Samsung group support. We see a trend of global auto OEMs preferring prismatic-type EV batteries for safety reasons, which led to SDI securing favourable volume terms under its JVs with Stellantis and GM.

We assume SDI plans to expand sales of P6/P7 batteries for key customers and maintain a high utilisation rate for 4Q24. The company is due to start mass production of 46-pi cylindrical batteries from 2025, and ASSBs from 2027. For ASSBs, it set up a pilot line in 2023 and business entity, expanding sample supply to global premium customers. SDI plans to increase capex by over 50% YoY in 2024, and we assume a further increase over 2025-27, to meet customer demand. We also expect Samsung Electronics (SEC, 005930 KS), the major shareholder, to support SDI's long-term investment.

We reaffirm our Buy (1) call on the stock and 12-month TP of KRW600,000, based on a target PER of 17.3x applied to our 2025E EPS. Key downside risk: a delayed recovery for cylindrical batteries.

LG ES aims to focus on the development of cylindrical batteries, low-end solutions and safety enhancement

LG ES (373220 KS, KRW420,000, Hold [3])

LG Energy Solution (LG ES) continues its R&D efforts in 3 major directions:

- 1) **Cylindrical batteries:** LG ES has initiated a trial run for its 46-pi battery production in 2024, aiming for mass production from late 2024 to early 2025. It has also set up a pilot line incorporating a dry-electrode process to meet the requirements of its key end-customers for 4680 batteries. Recently, LG ES announced a long-term contract with Mercedes-Benz, which we believe is the first 4680-battery order besides Tesla. LG ES has been striving to diversify its form factors and customer base, and it appears this strategy has been successful so far.
- 2) **Expansion into low-end solutions:** In July 2024, LG ES secured a contract with Renault, marking its first order for an EV LFP battery. LG ES plans to begin supplying LFP batteries for Renault's EVs from late 2025. The company has adopted cell-to-pack (CTP) technology for pouch-type LFP batteries for the first time globally, aiming to secure price competitiveness against Chinese competitors. Other than LFP, LG ES also plans to launch various different solutions, such as Mn-rich and Cobalt-free, targeting supply in 2026-27.
- 3) **Safety enhancements:** Following a series of fire incidents in various EV models globally, safety remains a key focus for LG ES. The company is working in various ways, including improving battery materials and components, to enhance the safety of its battery cells and modules. Simultaneously, LG ES is developing an advanced battery management total solution (BMTS) initiative. The advanced BMTS will help measure the temperature of battery cells to manage charging speed, safety, and the cycle life of its batteries.

Beyond these 3 main directions for the next 2-3 years, LG ES continues to work on next-generation solutions such as ASSBs and lithium-sulfur batteries.

We maintain our Hold (3) rating and 12-month TP of KRW400,000, based on a target EV/EBITDA multiple of 15.8x on 2025E EBITDA. Key upside/downside risks: in the short term, the largest volatility factor is the US election result, as Harris and Trump have relatively favourable and unfavourable policies toward EVs, respectively.

Panasonic (6752, JPY1,425, Hold [3])

The company's plant in Kansas (US) for the production of automotive lithium ion (Li-ion) batteries is set to come on stream by the end of March 2025. It has also inked strategic partnerships in Japan with Mazda Motor and Subaru involving the production and supply of Li-ion batteries for EVs. Panasonic plans to build new plants as well as bolster capacity at existing facilities, with an eye on starting mass production of such batteries in FY27. While it did cut the production capacity target for automotive batteries of 200 GWh that it had set for FY30, it has fleshed out a strategy for growth, underpinned by landing a greater share of supply to major customers and broadening its overall customer pool.

Panasonic already manufactures 1860 and 2170 cylindrical EV batteries. As for 4680 batteries, it is taking steps towards full-fledged mass production. The firm has started sending samples of 4680 cells to some automakers, and plans to launch mass production after it gets the green light. It also continues working to develop materials and new production processes to help it increase battery capacity as well as diminish some of the risks on the supply chain side. In terms of cathodes, Panasonic has already brought the level of cobalt down to under 5% by increasing the percentage of nickel used. It says that it looks to make cathodes free of cobalt within roughly the next two fiscal years. In addition, the firm has set its sights on producing nickel-free cathodes by some point after 2030.

Another example of efforts to create new materials for use came in July 2023, when a joint research group made up of members from Panasonic Energy, Yokohama National University, and Ritsumeikan University revealed that they had developed a manganese-based active material for cathodes. As for anodes, the firm looks to bolster capacity by using a greater percentage of silicon in the materials mix. It targets an increase in battery energy density from the current level of 800 Wh/L to 1,000 Wh/L by FY30. To bring this about, it intends to make use of new materials that can serve multiple functions.

We maintain our 3 (Neutral) rating on the stock with a 12-month target price of JPY1,400. Our price objective equates to roughly 0.7x our end-FY24 book value estimate, considering historical valuations. Key upside/downside risks: higher-/lower-than-expected volume shipments.

Risks to our Positive sector call

Lower-than-expected EV and ESS battery shipments

The key downside risk to our sector call is lower-than-expected industry EV and ESS battery shipments. If demand falls short of our expectations due to infrastructure issues, lower-than-expected battery installations per vehicle or lower-than-expected demand for ESS, lower-than-expected LiB shipments would negatively affect the profitability of battery players relative to our expectations. In particular, we expect massive capacity expansion by Tesla in the next decade, which would likely exacerbate the situation if demand is not yet in place.

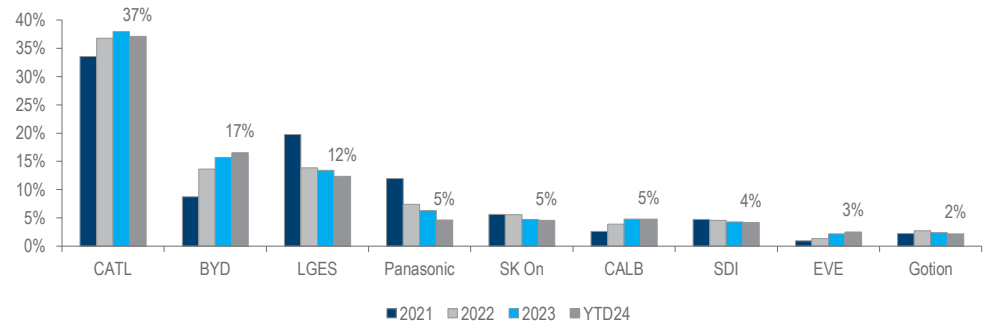
Stronger-than-expected volatility in raw-material prices

In 2025E, we expect a stable raw-material price environment given the already low lithium carbonate price of CNY70k/t. Stronger-than-expected price volatility would adversely impact market production and procurement sentiment, which in turn would impact battery supply chain profitability.

Lower-than-expected EV and ESS shipment is primary risk

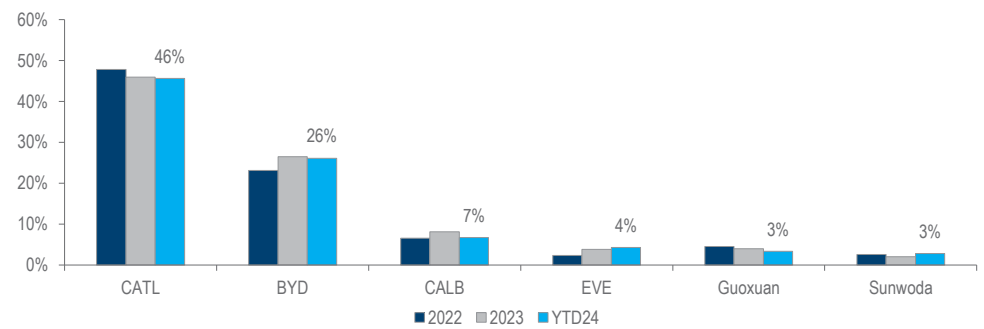
Appendix I: Global EV battery market-share charts

Global EV battery installations: market share by player



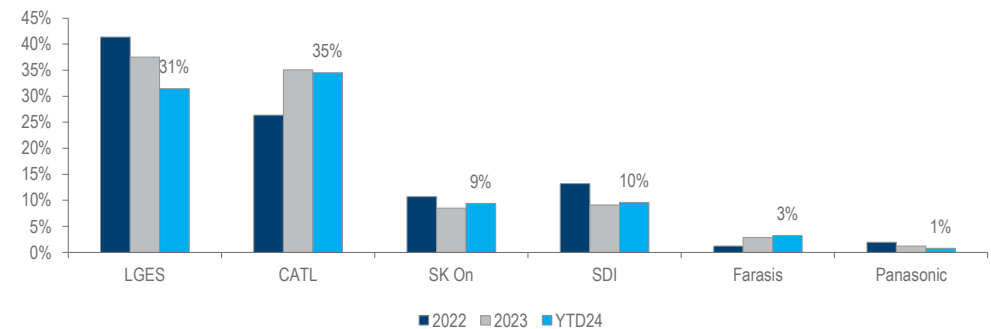
Source: SNE Research, Daiwa

China EV battery installations: market share by player



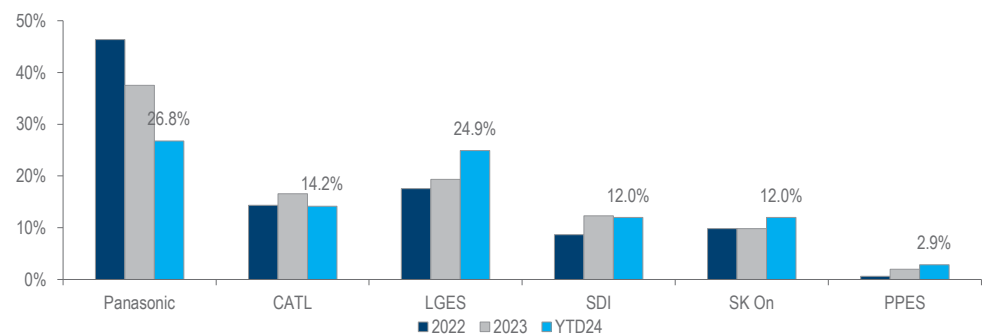
Source: SNE Research, Daiwa

Europe EV battery installations: market share by player

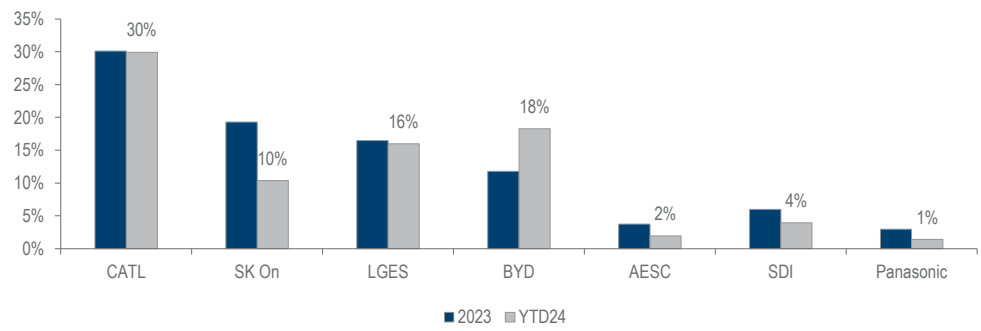


Source: SNE Research, Daiwa

North America EV battery installations: market share by player



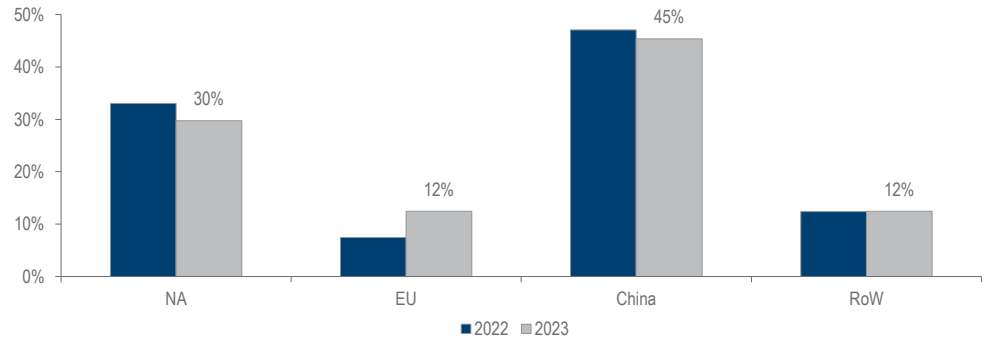
Source: SNE Research, Daiwa

RoW EV battery installations: market share by player


Source: SNE Research, Daiwa

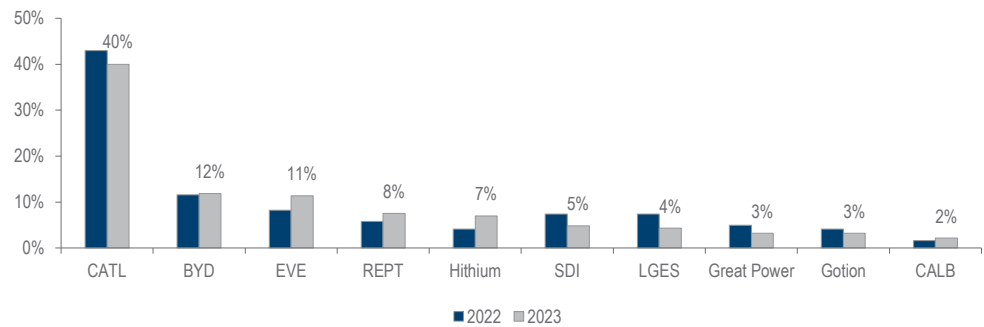
Appendix II: Global ESS battery market-share charts

Global ESS LiB: market demand split by region



Source: SNE Research

Global ESS LiB: market share by player



Source: SNE Research

Daiwa's Asia Pacific Research Directory

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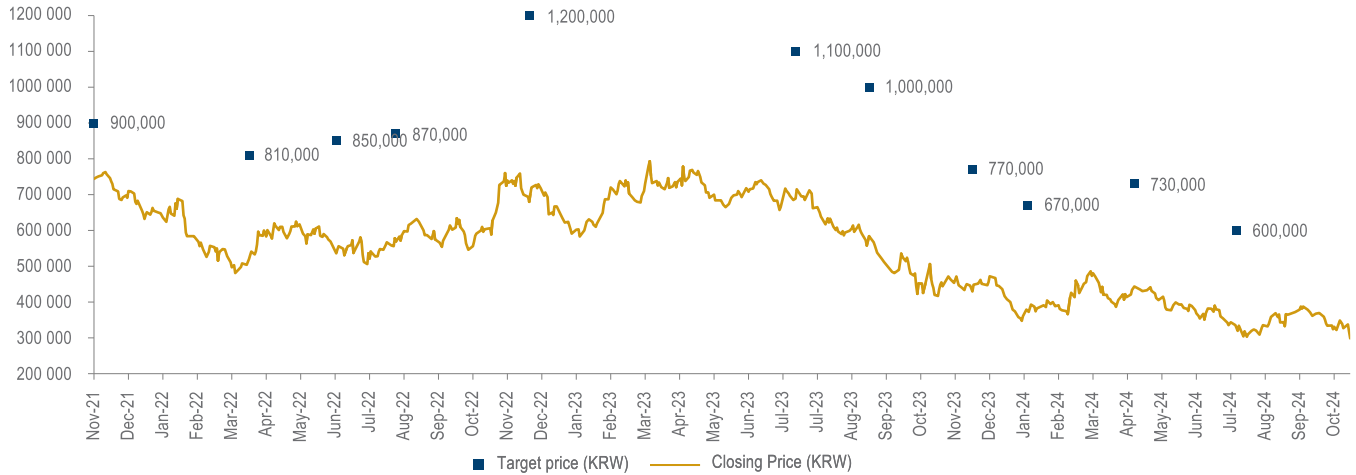
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Samsung SDI: share price and Daiwa recommendation trend

Date	Target Price	Rating	Date	Target price	Rating	Date	Target price	Rating
23/03/22	810,000	Buy	12/07/23	1,100,000	Buy	02/05/24	730,000	Buy
07/06/22	850,000	Buy	14/09/23	1,000,000	Buy	30/07/24	600,000	Buy
29/07/22	870,000	Buy	13/12/23	770,000	Buy			
22/11/22	1,200,000	Buy	30/01/24	670,000	Buy			



Source: Daiwa

Note: where appropriate, historical target prices have been adjusted to reflect the current share count

SK Innovation: share price and Daiwa recommendation trend

Date	Target Price	Rating	Date	Target price	Rating	Date	Target price	Rating
16/11/21	380,000	Buy	18/10/22	260,000	Buy	06/02/24	160,000	Buy
28/01/22	320,000	Buy	11/01/23	220,000	Buy	25/06/24	140,000	Buy
22/04/22	340,000	Buy	04/05/23	260,000	Buy			
29/07/22	310,000	Buy	13/10/23	230,000	Buy			

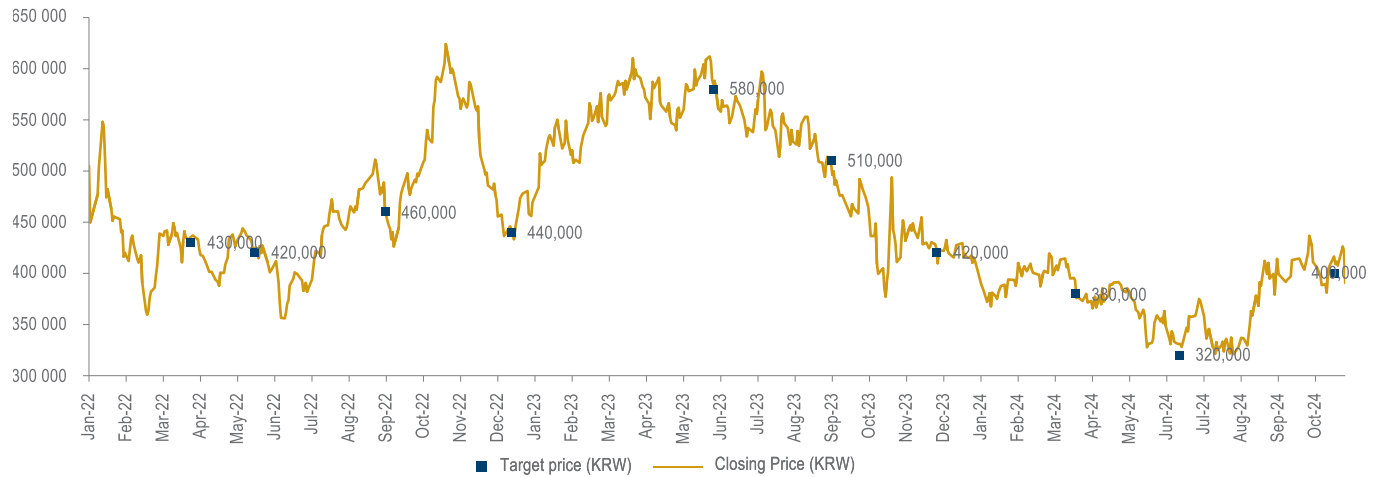


Source: Daiwa

Note: where appropriate, historical target prices have been adjusted to reflect the current share count

LG Energy Solution: share price and Daiwa recommendation trend

Date	Target Price	Rating	Date	Target price	Rating	Date	Target price	Rating
19/04/22	430,000	Hold	15/06/23	580,000	Hold	25/06/24	320,000	Hold
10/06/22	420,000	Hold	18/09/23	510,000	Hold	28/10/24	400,000	Hold
23/09/22	460,000	Hold	12/12/23	420,000	Hold			
03/01/23	440,000	Hold	02/04/24	380,000	Hold			



Source: Daiwa

Note: where appropriate, historical target prices have been adjusted to reflect the current share count

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Disclosure of investment ratings

Rating	Percentage of total
Buy*	72.39%
Hold**	18.84%
Sell***	8.77%

Source: Daiwa

Notes: data is for single-branded Daiwa research in Asia (ex Japan) and correct as of 30 September 2024.

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